Translated from the German

European Patent Office

EUROPEAN PATENT APPLICATION
EP 0 915 553 A2

IPC[6]: H02K 1/16; H02K 41/02
(43) Date the European patent application, on which no grant has taken place on or before the said date, has been made available to the public by printing or similar process: May 12, 1999, in Patentblatt 1999/19
(22) Date of application: October 28, 1998

---

(84) Countries, designated as high contracting parties to regional patent conventions:
AT BE CH CY DE DK ES FI FR GB GR IE IT LI LU MC NL PT SE
Countries, designated by extension as high contracting parties to regional patent conventions:
AL LT LV MK RO SI
(71) Applicant: SIEMENS AG, D-80333 Munich
(72) Inventor: Gerhard Huth, D-97618 Leuterhausen

(54) Title of the object of the invention: Linearmotor

LINEAR MOTOR

Description

The invention pertains to a linear motor.

Form the German 'Offenlegungsschrift' DE-OS 42 41 085 A1, there is known a linear motor, whose stator has slots for the accommodation of

former-wound* [* Translator's note: A.k.a. form-wound, or preformed coils]. The fixing of the former-wound coils in the slots occurs by means of prefabricated tooth-tip elements. From a structural standpoint, the design of this kind of fixing is very costly, involving a very high input. Moreover, flexural or bending processes may lead to damages of the former-wound coils. Form the professional engineering publication "*Wicklungen für flache Ständer und Scheibenläufer*" by H. Sequent [Windings for flat Stator and Disk-type of Rotors] (p 284f), there is known a two-layered winding, which is mounted on a stator, and is impregnated as a whole. A matching to a modified setting of the objective of the linear motor is not possible.

The objective to create a stator of a linear motor, which is designed modularly, can be expanded at any moment, and is simple to manufacture, forms the basis of the invention. Moreover, the stator should be suitable for any kind of winding.

The achievement of the set objective is successfully managed by means of the following features:

- stator teeth, which when assembled or set up individually or block-by-block, form a laminated stator core.
- prefabricated coils as free-from phase-shift fractional-slot windings,

degenerated into tooth-wound coils.

• stator teeth, outfitted with coils, which coils are fixed on the stator-tooth and/or laminated stator core, respectively.

By using tooth-wound coils in conjunction with individually or block-by-block connected stator-teeth, the linear motor can be designed modularly and - when needed - supplemented by additional modules. In doing so, the stator-teeth, or the modules are mechanically and magnetically coupled by means of slot-like and spring-like types of connections. The fixing of the tooth-wound coils to the stator-teeth can takes place as a result of a closure by adhesive force, so that - as a result of this - an impregnation of the tooth-wound coils concurrently takes place. The tooth-wound coils' connection to the stator-teeth, which is materialized as a result of a closure by adhesive force, leads - over the course of the manufacturing process - to an enormous saving of time, when juxtaposed to the conventional kinds of manufacturing of linear motors. Also, the fixing can take place as a result of frictional engagement, or a closure by adhesive force, e.g., by means of tooth-tip elements, designed in a dovetailed manner. The tooth-tip elements themselves can be designed as laminated or monolithic whereby the monolithically embodied tooth-tip elements consist of an iron composite material.

As a result of an advantageous design of the invention in three

winding-phase modules, having three tooth-wound coils, respectively, the number of pole pairs of eight or ten can be adjusted or calibrated for a three-phase connection to the wooer supply. Because - for reasons of the magnetic utilization - the coil pitch (slot pitch) could approximately correspond to a phase spacing (distance between pole centers), and, therewith, approximately to the number of poles, in the case of a three-phase linear motor, having nine teeth, there accordingly ensues a usable basic pole number of eight or ten. The desired basic pole number is repeated by a reaction part of the linear motor, which reaction part has preferably been excited by an electric motor.

The invention is elucidated in grater detail in a diagrammatic representation wherein

Fig. 1 shows individual stator teeth - connected to another - having tooth-wound coils.

Fig. 2 shows a principal circuit diagram of a winding phase,

Fig. 3 shows a longitudinal section of a stator, consisting of nine slots, and three phase module windings.

Fig. 1 shows individual laminated stator teeth 1 of a movable short stator, having tooth-wound coils, which are attached in a frictional engagement, or by means of dovetailed connections 3 of the stator tooth-roots 4. A fixing of the tooth-

wound coils 2 can also be achieved by menas of slot-seal (slot-wedge) parts 20. A connection 5 - based on a closure by adhesive force - of the tooth-wound coil 2 to the stator 1 is used - in addition to this - for the impregnation of the tooth-wound coil 2. The impregnation does not comprise the frontal side 11 of the stator tooth 1, which frontal side is diametrically opposite to a rotor that has not been diagrammatically represented.

The individual stator teeth 1 can be arranged as modularly joined together in a line by means of slot- and spring-connections 6 or other generally known mounting or interconnection techniques. As a result of the mechanical arrangement 6 in the form of joining together in a line of the stator teeth 1, there ensues a magnetic return yoke.

Fig. 2 shows the principal wiring diagram of a winding phase 7, from the standpoint of the rotor that is not diagrammatically represented in greater detail, having tooth-wound coils 2, which are attached on the stator teeth 1 as a result of a closure 5 by means of adhesive force. The frontal sides 11 of the stator teeth 1, which frontal sides are facing the rotor, are free of impregnation materials. The stator teeth 1 of this winding phase 7 are assembled or built-up as depicted in Fig. 1, or the laminated sections form "three-teeth" configurations 8. Therewith, the single-tooth or three-teeth modules are suitable for a three-phase electrical design

L1, L2, L3. The neutral point (star point) of a three-phase design of this kind is characterized or denoted by reference symbol 21. The energy supply or input also takes place during the linear motion of the short stator by means of cable tows, which are not diagrammatically represented.

Fig. 3 shows a movable short stator, having nine slots and three winding phase modules 8, whose stator teeth 1 represent a three-teeth configuration 8, and whose tooth-wound coils 2 are connected in conformity with the interconnection depicted in Fig.2. This embodiment form allows a three-phase connection to the power supply L1, L2, L3, accompanied with an adequate utilization of the magnetic material, because the slot number "nine" approximately corresponds to the pole number "eight' or "ten".

Patent Claims

1. Linear motor (1), having the following features:

a) stator teeth (1), which individually or block-by-block form a laminated stator core,

b) prefabricated coils as free-from-phase-shift fractional-slot windings, degenerated into tooth-wound coils (2).

c) stator teeth, outfitted with coils, which coils are fixed on the stator-tooth and/or laminated stator core, respectively.

2. Linear motor, as claimed in claim 1, **characterized in that** the entire laminated stator core is assembled out of mechanically and magnetically segment-wise connected stator-teeth (1), which form in a block-by-block manner a winding phase module (8), which is independent mechanically and electrically, respectively.

3. Linear motor, as claimed in claim 2, **characterized in that** the tooth-wound coils (2) of each winding phase module (8) are connected in series, and that the tooth-wound coils (2), connected in series, are connected to the stator teeth (1) as a result of a closure by an adhesive force, and/or by means of stator tooth-roots (4), or slot-seal (slot-wedge) parts (20) means of frictional engagement and/or as a result of a closure by means of adhesive force.

4. Linear motor, as claimed in claim 3, **characterized in that** the laminated stator core consists of three winding phase modules (8), having nine slots, and of the tooth-wound coils (2) - fixed in the slots - and switched in series per each winding phase.

Translated by John Koytcheff , M. Sc. (Engrg.); WHO Postgrad. Fellow (Env. Engrg.); USNWC Graduate
The USPTO Translator from German & Germanic languages
USDoC/USPTO
August 13, 2009

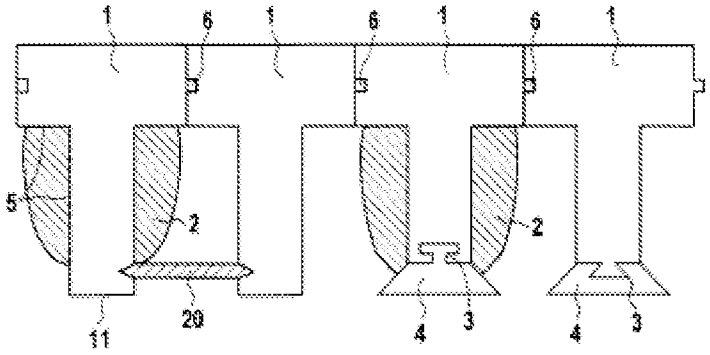

FIG 1

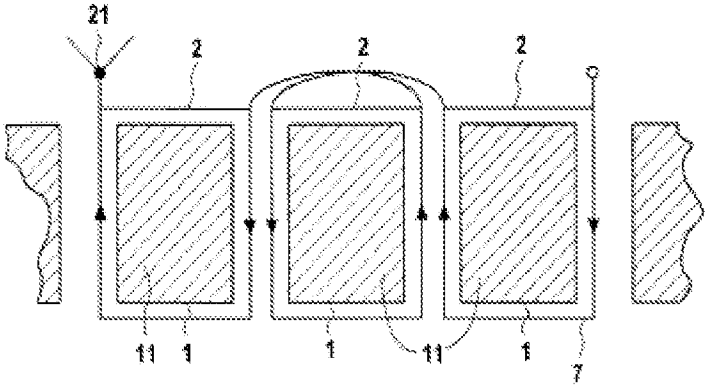

FIG 2

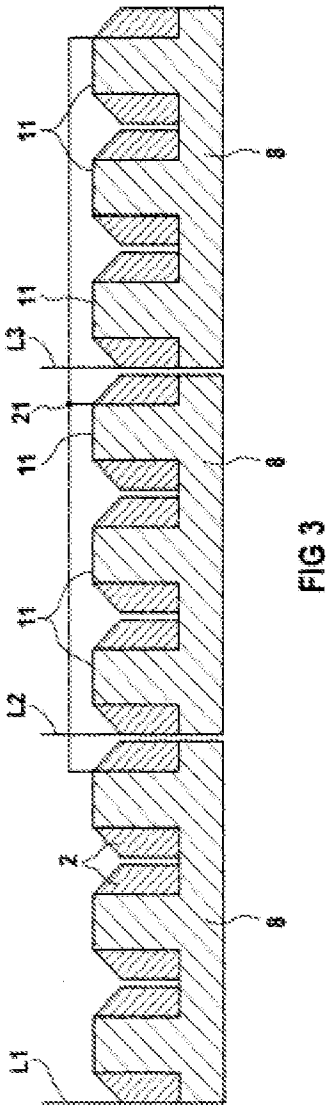

FIG 3